THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION

[Entered at the Post Office at Honolulu, T. H., as Second-class matter.]

VOL. XXVIII.] HONOLULU, OCT. 15, 1909. No. 10.

SUGAR PRICES SEPTEMBER 14 TO OCTOBER 14, 1909.

Date.		96° Centrifugals		88° Beets	
		per lb.	per ton	per 100 wt.	per ton
Sept.	14	4.16¢	$83.20	11s 9d	$89.80
"	15	"	"	11s 9d	"
"	16	4.21¢	84.20	11s 9¾d	90.00
"	17	"	"	11s 9¾d	"
"	18	"	"	11s 9¾d	"
"	19	"	"	11s 9¾d	"
"	20	4.23½¢	84.70	11s 8¼d	89.40
"	21	"	"	11s 8¼d	"
"	22	"	"	11s 9d	89.80
"	23	"	"	11s 8¼d	89.40
"	24	"	"	11s 9d	89.80
"	25	"	"	11s 9d	"
"	26	"	"	11s 9d	"
"	27	"	"	11s 9d	"
"	28	"	"	11s 9d	"
"	29	"	"	12s 7½d	93.60
"	30	"	"	12s 7½d	"
Oct.	1	"	"	12s 7½d	"
"	2	4.20¢	84.00	10s 10½d	85.80
"	3	"	"	10s 10½d	"
"	4	"	"	10s 9¾d	85.60
"	5	4.235¢	84.70	10s 10½d	85.80
"	6	"	"	11s	86.40
"	7	"	"	11s	"
"	8	"	"	11s 6d	88.60
"	9	"	"	11s 6d	"
"	10	"	"	11s 6d	"
"	11	"	"	11s 6d	"
"	12	"	"	11s 6d	"
"	13	4.30¢	86.00	11s 4½d	88.00
"	14	4.25¢	85.00	11s 3¾d	87.80

U. S. FOUR PORTS SUMMARY TO OCTOBER 7, 1909, IN TONS (INCLUDING NEW YORK, BOSTON, PHILADELPHIA AND BALTIMORE).

(The New Orleans Statistics Given Elsewhere.)

	1909 Oct. 7	1908 Oct. 8
Receipts for week from Cuba	6,713	857
" " " " Porto Rico	......	......
" " " " other W. I. Islands	595	......
" " " " Brazil	......	......
" " " " Philippine Islands	......	......
" " " " Europe	......	......
" " " " Java	17,170	47,540
" " " " Hawaii	18,310	12,525
" " " " other For'gn Co'tries	700	......
" " " " of Domestic	74	18
" Total tons for week	43,562	61,140
" increased since last week	17,465	......
" for week to Importers	......	11,527
" " Refiners	43,562	49,613
" since October 1	11,131	50,009
" " Jan. 1, from Cuba	1,298,611	851,933
" " " Porto Rico	169,947	137,474
" " " other West Indies	27,835	78,703
" " " Brazil	2,825	353
" " " Philippine Islands	4,400	45,089
" " " Europe	326	77,388
" " " Java	71,145	§§223,304
" " " Hawaii	228,602	229,608
" " " other Foreign Countries	4,621	6,203
" " " of Domestic	9,342	21,303
Total Receipts since January 1	1,817,654	1,671,358
Receipts of Refined for the week incl'd above	......	......
Receipts of Refined since January 1	326	1,012
Deliveries for week	46,950	49,613
Deliveries for week increased since last week	11,424	......
Deliveries since January 1	1,803,332	1,659,879
Meltings by Refiners for week, estimated	47,000	45,000
Meltings by Refiners same as last week	......	......
Meltings by Refiners since January 1	1,750,000	1,510,000
Export of Refined Sugar for week	137	38
Export of Refined Sugar since January 1	30,567	5,011
Export of Raw Sugar since January 1	1,825	.....

Consumption of U. S. through all ports, including all sugar, foreign and domestic, year 1908, 3,185,789 tons; year 1907, 2,993,979 tons.

Importers' Stock, October 6	31,421	17,099
" " decreased since last week.	3,388	......
" " at highest point	54,757	30,012
Refiners' Stock, New York, October 6	90,755	166,566
" " Boston, October 6	19,740	25,896
" " Philadelphia, October 6	26,917	67,838
" " decreased since last week	50	......
Total Stock in all hands, Oct. 6, estimated	168,833	277,339
" decreased since preceding week	3,438	......
" in all hands, January 1	101,179	115,981
" at highest point in year*	406,483	331,145
" at lowest point in year**	66,599	78,415
Price of Centrifugals, 96°, spot, Oct. 7	4.235	3.98
" " same as last week	......	......
" " high't dur'g year††	4.235	4.49
" " lowest dur'g year†.	3.61	3.67

* June 2, 1909 ** Jan. 20, 1909. †† Sept. 23, 1909. † Feb. 10, 1909.
* May 27, 1908. ** Jan. 29, 1908. †† Apr. 22, 1908. † Feb. 13, 1908.
§§ Including 14,605 tons from store in Liverpool.

BEET SUGAR INDUSTRY.

Weather and Crop.—The proverbial ill-wind that brought disaster to the cane crop in Cuba and Louisiana had its beneficial effect upon the beet industry in the United States because of the rain which followed. West of the Missouri the rain was, however, conspicuously absent. Light frosts were felt for a few days in several of the beet growing states and these were followed by warm sunshiny days that topped off the favorable conditions and harvesting should come along as per schedule. Portions of California had their first rain in September, the clouds having been practically free from moisture since March. This was noticeably the case in the vicinity of San Francisco.

San Francisco Receipts, From January 12 to September 20, the receipts of sugar at San Francisco are reported as follows:

	Tons	
From—	1909.	1908.
Hawaii	163,866	195,507
Philiphine Islands	.....	.....
Central America	2,158	1,618
Java	.....	.....
Peru	1,990	.....
China, Mexico, etc.	303	230
Total	168,317	197,355

The comparative statement shows that there has been an increase in receipts from all ports. Java and Peru, for instance sent none during 1908 while during the current year they show signs. Philippine Islands is not reported in the list probably because at the time it was made the planters of that archipelago had not shipped under the new tariff. While not likely to be a heavy shipper at any time it may be expected that the reports a year hence will be of a different complexion in so far as the Philippines are concerned.

LOUISIANA CANE.—Optimists incline toward a rosy view of the situation in Louisiana though considerable damage followed in the wake of the great storm which passed over that state during the closing days of September. Hawaii is not called upon to watch for storm signals as is the case with the planters on the mainland and in the West Indies.

THE CUBAN CROP.—Cuban canes are reported, generally, this season, as sweet, an indication according to Cuban theory, that the growth is not large. It is expected that by the first of November the mills will begin grinding. The planters expect a full crop, minus about ten per cent, the estimated damage from the September storm.

THE RECORD PRICE.—As the last form for the October Planter goes to press Frank Atherton received advices of the arrival of the Texan on the Atlantic side with her 12,000-ton cargo. This was sold at the season's record price of 4.30 or $86.00 per ton.

SUGAR PRICE SITUATION.—An exchange of a recent date is of the opinion that when sugar was selling at 4.235 it should have been in demand at four and a half and puts the blame on the manipulators in New York. Scarcely had the issue containing the kick reached here when advices were received that the price had reached 4.30, or a shade above the price quoted as what it should be. The belief that it should rise was borne out by the advance which followed the expression of it.

CUBAN CENTRIFUGALS 96 were sold at 4.235 on September 30 against 3.98 same date one year ago.

THE NEW YORK PRICE OF REFINED granulated sugar in 100-pound bags was 5.15 on September 30 as against 5.20 on the same date one year ago.

THE VISIBLE SUPPLY seems to be growing less from week to week. For instance, on September 30 the total stock of Europe and America was 819,271 tons as against 963,190 a year ago. For the week the decrease is 198,923. The total stocks in storage and afloat is 1,041,271 tons while a year ago it was 1,256,190. Apparently this is an indication of greater consumption of sugar as the price of refined dropped a shade from the price a year ago.

CUBA CROP.—Corrected figures show the movement of crop, as compared with two previous campaigns from the standpoint shown by the following:

	1909	1908	1907
Stock of entire island, Jan. 1, of old crop	1,485,000	961,908	1,427,673
Estimated crop	1,483,000	971,276	1,427,673

	1909	1908	1907
Receipts at United States Four Ports and New Orleans, since beginning of crop	1,395,000	867,318	1,307,000
Estimated afloat to United States	12,000	6,000	7,000
Consumption of Cuba, Jan. 1, to date	44,000	41,000	32,000
Export and consumption	1,451,000	914,318	1,346,000
Balance supply, estimated	34,000	56,958	81,673
Estimated stock in island this date	28,000	38,000	81,673
Estimated Total Visible Production to date	1,479,000	943,000	1,427,673
Received in United States Four Ports and New Orleans, entire year	......	911,742	1,349,400
Consumption of Cuba, entire year	......	62,287	57,471
Stock carried over to next crop	......	None	9,318

FRANCE, September was one of variable weather throughout the Republic and harvesting has been interrupted by the absence of suitable conditions. Dry weather and sunshine is necessary to improve the beet crop. Reports up to the middle of September show backwardness in the development of the root and tests showed the weight at 367 against 446. Sugar content 15.15 per cent. This is the difference in weight of over 18 per cent in the root and 21 per cent in the sugar content. Hence the extreme need of warm and dry weather.

AUSTRIA.—For the first half of the month of September the weather conditions throughout the kingdom were favorable to the development of the beets rather than to the growth of the roots. Consequently the weight continues far below the average of that of last year. Whatever lack of moisture was noticeable has been partly helped by the rains that have fallen. Dry weather is never appreciated by the factories as it adds to the difficulty of pulling the beets.

HOLLAND.—Beets have improved throughout the country (though the weather conditions have been unfavorable to all other branches of agriculture), and have polarized 16 per cent. The average tests show 14 per cent, sugar content and 600 gross weight of root as against 16.2 per cent sugar and 650 gr. weight at a corresponding date last year. Harvest will begin two weeks later than in 1908 and most of the factories will be in operation early in October.

The amounts of sugar and molasses manufactured in Barbados and exported during the present year, to August 26, are 12,327 tons and 67,278 puncheons, respectively. Last year, the quantities for a similar period were 31,631 tons of sugar and 53,125 puncheons of molasses.

There are men engaged in the cultivation of sugar in Porto Rico who have had experience in the same line of agriculture in these islands. They know the value of men who have been trained according to the methods here and are often anxious to add to their corps of employes island trained men. In this issue is an advertisement for a luna having certain qualifications. There is no doubt that the right man will be found.

The fifty-ninth semi-annual statement of the Yokohama Specie Bank shows a very healthy condition of that institution. After declaring a twelve-per cent. dividend amounting to 1,140,000 yen there is a reserve balance of 1,155,841.28 yen. The local branch of the bank hopes to be in its new quarters in January. The building is in strong contrast to the place occupied on Nuuanu street fifteen years ago and is a monument to the men and their careful management of the institution.

THE MOSQUITO FLY.

Possibly Hongkong may have to be drawn upon to furnish an enemy to the mosquitoes which infest this Paradise. Dr. Allhusen of that city, has found the family of the Dolichopodidae or long-legged flies, some of which are small or medium size and generally bright metallic green in color. The larvae are long, slender and round and live in earth or decomposing matter. It is the perfect insect or image, however, that is said to be useful in a mosquito campaign. This is predaceous and hunts for small soft-bodied insects. Its habitat is in damp places covered with rank vegetation, on the leaves of aquatic plants or on water, over the surface of which it is able to run. Very likely they are able to attack the mosquito larvae which have risen to the surface of the water to breathe. If this is so the "transplanting" of such a fly in this Territory would have some bearing on a campaign to rid the country of the pests and, perhaps, keep it clear of the "yellow fever" mosquito that has been talked of by the sanitary officers.

THE NITRATE SUPPLY.

Fifty years ago it was estimated that the nitrate beds would supply the world for fifteen hundred years, but the development along agricultural lines, and the scientific prosecution of it has proven the fallacy of the prediction. Fertilizers are carefully considered in the estimates of an agricultural campaign and the mainland farmer realizes the necessity for its use on his soil if he would get the best results. The use of nitrates in the manufacture of fertilizer has reached the enormous quantity of one and one-half million tons per annum and at that rate a few decades will see the end of the source of supply. On this subject the Gardeners' Chronicle for February says:

Since the investigations of Liebig, Boussingault, Lawes and Gilbert, during the first half of last century, into the nature and sources of the elements necessary for the nutrition of plants, the great importance of an adequate supply of nitrogen has become fully recognized by all who are concerned with the cultivation of the land. Among plant-food constituents nitrogen may be said to take first place, being at once the most costly, and, under the ordinary conditions which prevail in the garden or on the farm, the most effective element for increasing the yield of all kinds of crops. Without the constant addition of an abundant supply, either in the form of organic material such as dung, or as nitrate of soda or other chemical fertilizer, the cultivation of field and garden produce rapidly becomes unprofitable.

RAILWAY ON HAWAII.

Progress is being made on the extension of the railway from Hilo towards Papaikou, which point will be reached early in the new year and it is expected that trains will be in operation by July 1. Three hundred graders are at work in gangs in different localities and culverts of concrete have been erected over several of the gulches. Concrete piers have been finished across the Wailuku river from the Hilo side to the center of the stream. The birdge at this point will approximate six hundred feet in length and will be below the present lower foot bridge. Practically it is just at the mouth of the river and for that reason its length will be much greater than if a point higher up stream had been selected. Delay has been experienced through the non-arrival of the structural iron work for the bridges and some of the other material. The bridge across the picturesque Honolii gulch, three miles from Hilo will be a long one and will cross the gulch above the present carriage bridge and near the point that juts into the stream at that place. A gravel bank was found in the vicinity and much material is being taken from there for use in grading.

From this section of the road grading is facilitated through the good offices of Manager J. T. Moir who allows the railway company the use of water for sluicing, a privilege not available nearer Hilo for the reason that the United States will not allow any soil to be thrown into the waters of the bay. Had it been permissable there grading would have been finished this date.

The people in the Hamakua district seem in earnest in their request that the railway be extended to their section as soon as possible. Unquestionably the residents of that portion of Hawaii will patronize the road and Hilo is sure to be benefited by it. There is no expectation that any of this crop of sugar will be taken by the railway.

SUGAR GROWING AND MANUFACTURE IN NORTHERN INDIA.

By Mr. C. J. Mackay, Superintendent of Cawnpore Sugar Works.

Several attempts have been made in recent years to manufacture white sugar direct from sugar cane as is done in the West Indies, Egypt, Mauritius and other sugar-growing countries.

Considerable capital has been invested in these undertakings, the best up-to-date machinery imported from Europe, and skilled Europeans with expert knowledge, commercial, technical and scientific, have been employed. In spite, however, of what would appear to be most favorable auspices, careful supervision and a very large demand for the manufactured article, none of these undertakings have so far achieved more than a very moderate success, and most have had to face serious pecuniary loss.

The Striped Caledonia Variety.

The Hawaiian Planters' Record.]

In Bulletin No. 26 of the Division of Agriculture and Chemistry reference was made to a green and yellow striped cane having originated from a stool of Yellow Caledonia at Grove Farm Plantation, Kauai. Through courtesy of Mr. E. H. W. Broadbent a small lot of cuttings from this sport were supplied the Experiment Station, and the new variety under the name of Striped Caledonia is now being propagated in the Station field for general distribution in 1910. As young plant cane, it is now distinctly ahead of its parent, Yellow Caledonia, planted at the same time, and subjected to the same conditions with respect to irrigation and fertilization; it is a quicker germinating cane and is characterized by a more rapid early growth and thicker stand.

C. F. ECKART.

PESTS AND PARASITES.

The Hawaiian Planters' Record.]

Albert Koebele's phenomenal success with *Novius cardinalis* against Icerya in California in 1889 was the starting point for a new regime in applied entomology, especially in States bordering on the Pacific and in these islands. The blessings stored in the utilization of beneficial insects, that were but dreams until then, suddenly appeared to suffering farmers in unquestionably practical form. Here was a source of relief from insect depredations that was inexpensive, possessed of numerous qualities making it immeasurably superior to artificial warfare and opening a vista of ease and profit beyond the dream of avarice. Such was the hue in which Koebele's brilliant achievement was seen by the average fruit grower and horticulturist, uninitiated into the intricacies of applied entomology. Indissolubly coupled with the work of ransacking the world for beneficial insects was the institution of inspection and quarantine of all live vegetable matter imported into the State. The first to enjoy the benefits of a useful insect, California was the pioneer to establish (1890) entomological inspection of which the late, lamented Alexander Craw was the head.

Of the benefits of a beneficial insect Hawaii first tasted in 1890, and in 1893 she retained the services of the ablest collector of man's insect friends and enjoys them to the present day. The horrible depredations of the sugar cane leaf hopper induced us in 1904 to bring to our shores the most expert of inspectors also, and this effectively closed our gates against invasion by insect pests. Our isolated position permits of most thorough exclusion, though our anchorage in Mid-Pacific, surrounded by countries similar in climate and inhabited by countless potential pests, makes our situation precarious *unless our inspection is most vigilant.*

It is not the writer's belief that all artificial remedies are to be abandoned in anticipation of relief from insect friends. No general rule can be made in this respect, depending as it does upon the conditions surrounding the affected crop. It was absurd to attempt artificial remedies against the cane leaf hopper; it would be equally absurd for one cultivating citrus trees on these islands for profit to let his trees suffer from damage by aphis, while awaiting effective attack by their parasites (an ultimate certainty), when an application of soap solution would kill all the aphis on his trees at one fell swoop. The aphis-destroying insects are in this case useful where artificial battle is incompatible with circumstances, as inaccessibility, laxity, or poverty of owner, to reduce the numbers that would migrate to the cleansed area. No insect, native or foreign, is anywhere destructive without suffering from attacks by some enemies.

To the immediate relief of the threatened crop we must bring either its depredator's enemies or insecticides. The latter must be used if practicable until the former be found. Natural enemies are preferable and always worth searching whenever circumstances permit. That the work of introduction of our insect friends from foreign lands is beset with a certain amount of risk and *should never be undertaken by others than competent entomologists* goes without saying. But in the light of what has been accomplished with direct importation of useful insects here and abroad it seems utter folly to attempt to misrepresent or discredit it. Thus, although Dr. Marchal's memoir was published in 1908 (Popular Science Monthly, April and May), and he speaks of the Koebele and Perkins expedition to Australia in quest of parasites of *Perkinsiella saccharicida*, he does not give the brilliant result of that expedition! Less pardonable still is Mr. Froggatt's belittling account of the result of this expedition. Mr. Froggatt is the eminent Australian entomologist who, commissioned by four Australian States to investigate principally fruit fly enemies and remedies, spent about a month in our midst about two years ago on his way around the world. For the workers directly engaged in the work of introducing, breeding and distributing beneficial insects, for the scientists and businessmen to whose attention whether in a scientific or commercial way the work of these insect friends is brought daily,—for these people Mr. Froggatt had little time to spare. Such attitude presaged not only the trend of his forthcoming report but also reflected the prejudiced frame of mind in which he must have set out on his expedition, unscientific as it would seem. Mr. Froggatt's report on entomological work in Hawaii is set forth in his preliminary letters published in the Agricultural Journals of the States he represented, and his final report appears somewhat more fully in a special publication received a short time ago.

To correct Mr. Froggatt's evident errors we reproduce below a note from a recent number of the Hawaiian Planters' Monthly, also quote the major portion of a paper recently published by the eminent Italian scientist, Dr. F. Silvestri, which has direct bearing on our entomological work and method. Dr. Silvestri spent also about a month with us about a year ago and embodies his observations in this paper. We took the time to translate his paper and the pleasure now to publish it, because in the original Italian it would have remained a dead letter to most of us. It remains for us only to express our gratitude to Dr. Silvestri for the fairness with which he studied and reported on our work. His paper contains besides a fund of valuable and absorbing information, which would interest and pay our readers to peruse.

BAGASSE FURNACE INVESTIGATIONS.

The Hawaiian Planters' Record.]

The Louisiana Experiment Station has recently begun a series of investigations which are an inovation in experiment station work. About a year ago a bulletin appeared on "Preliminary Tests of Sugar House Machinery," by E. W. Kerr,* and this summer another paper by the same writer has been published on the subject of "Bagasse Furnace Investigations."†

The great need of careful scientific investigation into the engineering problems of sugar factory machinery is apparent to anyone who becomes interested in getting the highest efficiency out of it, and especially to the engineers themselves.

In the present investigation the writer states that "the object of the tests was to gain a thorough insight into the method in vogue in Louisiana for utilizing the heat from bagasse, both by general observation and by experimental data gathered." In Louisiana even the best designed sugar houses are able to obtain only two-thirds to three-quarters of the power required for their operation from the bagasse. Some houses use four times as much extra fuel as others, on account of loss of energy in the boiler furnaces, and "improperly designed and uncovered steam piping; failure to provide for the utilization of the heat in the exhaust coming from the different engines of the house, resulting in much of it passing out above the roof; absence of feed water heaters; the failure to use the water of condensation from steam piping, evaporators, pans, etc.; the use of mill and other engines extravagant in the use of steam; evaporation in open vessels instead of multiple effects; the use of a larger number of small steam cylinders where a smaller number of large cylinders could have been used, etc."

Loss of energy in the boiler furnace shows itself in abnormally high temperature in the smokestack. This should not be over 500 degrees Fahrenheit. High temperature is due to too large a grate surface to the heating surface, and to incrustations or soot on the heating surface of the boiler. With a consumption of "100 lbs. of bagasse per square foot of grate surface per hour and a normal evaporation of 3 lbs. per square foot of heating surface per hour," the writer calculates that the proper ratio of grate surface to heating surface is 1 to 75.

"The volume of air admitted to a furnace per pound of combustible has much to do with its efficiency." The most economical amount to admit is considered to be about 150% of the theoretical volume necessary to convert all of the carbon

* See review by Noël Deerr, "Hawaiian Planters' Monthly," 1908, p. 396.

† "The Louisiana Planter," June 12, 1908, p. 380.

in the bagasse into carbonic acid, or 50% "excess." More than this "is harmful in cooling the furnace." The excess varies with different designs of furnaces and also with different methods of operation. "The quantity of bagasse burning per square foot of grate in a given time also affects the question of 'excess air'." The investigation showed that for the most efficient service the grate should be so proportioned that the consumption of bagasse will be in excess of 125 lbs. per square foot of grate per hour.

It is proposed to continue the investigation during the coming grinding season.

As far as this kind of investigations concerns Hawaii, it may be said that this Territory has for a number of years occupied a leading position in the development of sugar house machinery, thanks to its able engineers, and has long since passed the stage of evaporation in open vessels referred to by Mr. Kerr, but there are yet many problems whose solution would make it possible to even further increase the efficiency of the factories being built to replace the old ones. Is it not possible that the solutions would be brought about more readily by the method of the Louisiana Station than by other older methods?

R. S. NORRIS.

THE SUGAR INDUSTRY IN QUEENSLAND.*

The Hawaiian Planters' Record.]

A number of central factories were a number of years ago started in Queensland under government loans; eventually the government was obliged to foreclose on their mortgages, and to take over the working of the mills. Dr. Maxwell was appointed comptroller, and under his direction several mills have been freed of debt and returned to their original proprietors. The report under review refers to the Gin Gin, Mount Bauple, Nerang, and Proserpine mills, still in the hands of the Treasury. Extracts from the report of general interest are given below.

Size and Number of Cane Growers.—All these mills are central factories pure and simple, the mill purchasing cane from a number of planters who also form, (I believe), the principal proprietors of the mill. For the year 1907 the number of cane growers and the total cane crushed was as follows:

	Number of Growers.	Tons of Cane Produced.	Tons of Cane per Grower.
Proserpine	165	49,828	319
Gin Gin	80	42,242	528
Mount Bauple	54	15,026	279
Nerang	58	8,336	143

* Report upon the Government Central Mills, 1908. Dr. W. Maxwell, Comptroller.

Price Paid for Cane.—The price paid for cane varied from 10s 2d to 13s 1d per ton;† this would correspond to from $2.18 to $2.80 per short ton. This price apparently refers to cut cane in the field, as in the financial statements reference is made to payment to the growers for haulage to the railroad.

Production of Cane per Acre.—Compared with the results here the production per acre appears very low; it is shown in the following table:

	Tons of Cane.	Average.	Tons of Cane per Acre.
Proserpine	49,824	3,094	16.1
Gin Gin	42,240	2,418	17.4
Nerang River	8,335	619	13.4

The crop from incomplete figures given appears to be divided between plant and ratoon cane in the proportion of about two ratoon to one plant. Mention is also made of "standover cane" which would appear to correspond with "long ratoons."

Plant.—The mills reported on are equipped with six-roller mills only; the rest of the plant seems to be of the usual pattern. In the report from the Proserpine Mill the following remark occurs: "The juice from the second mill was returned to the megass in the maceration bath to the extent of say 7 per cent. of the volume of the maceration water." This procedure being unusual in these islands is described in a separate note immediately following.

Factory Results.—These are given in some detail and from these the following figures are abstracted:

		Proserpine.	Gin Gin.	Mount Bauple.
Cane	Sugar %	13.82	13.55	14.70
"	Fiber %	11.10	10.76	12.64
First Mill	Brix	18.86	18.53	20.03
"	Sucrose %	16.38	15.92	16.80
"	Purity	86.85	85.91	88.86
"	Glucose %	1.00	.70	.63
Mixed Juice	Brix	13.99	14.16	13.78
"	Sucrose %	11.83	11.90	11.86
"	Purity	84.56	84.04	86.06
"	Glucose %	.73	.48	.65
"	Extraction	91.22	92.26	87.04
"	Dilution	28.81	24.86	39.35
"	per 100 cane*	100.4	107.5	110.4
Bagasse	Sucrose %	5.09	4.62	6.46
"	Water %	47.04	46.91	48.43
Sucrose shipped per 100 sucrose in cane		75.9	76.9	67.6
Tons cane per ton sucrose		9.66	9.71	10.10
Tons cane per ton sugar		9.08	9.12	9.49

† Presumably a long ton.

* These figures do not appear in the report, but have been calculated from data there appearing.

Cost of Production.—The details are given of the cost of production of a long ton of sugar of 88 N. T. in pounds, shillings, and pence. The principal items are here translated into short tons, 94 N. T., and dollars and cents, so as to compare directly with Hawaiian conditions.

	Gin Gin.	Mount Bauple.	Proserpine.
Wages in factory	3.68	5.80	5.04
Purchase of cane	21.50	22.84	25.60
Transport of cane	1.38	.93	.47
Salaries	1.21	1.64	1.27
Fuel	1.00	1.29	.68
Supplies	.62	.98	.48
Maintenance and renewals	4.55	5.05	3.18
Sugar charges	1.80	.83	.32
Sundries	1.66	1.24	.86
Total	37.40	40.60	37.90

NOEL DEERR.

MACERATING BATHS.

The Hawaiian Planters' Record.]

In the immediately preceding abstract concerning the Queensland sugar industry mention is made of a macerating bath. This is an appliance which is, I believe, practically unknown in these islands, and opportunity is now taken to refer to them. In *Fig. 1* is shown a bath connecting two of a train of mills: the bath is constructed of boiler plate; the depth of the diluted juice in the bath is 8 inches, the height being regulated at will by adjustment of a sluice valve at the end of the bath next the mill A; bagasse from mill A falls into the bath and is carried forward to mill B by the scraper carrier moving in the direction indicated by the arrows, and delivered on to the feeding plate of the mill B; diluted juice, or diluted juice and water, enters the bath at the end near the mill B, flows in a direction contrary to the travel of the bagasse, and overflows at the end next the mill A.

In *Fig. 2* is shown another design of bath with a distance between the mills of only 18 feet, and owing to the angle of the shoot being of small grade, a shorter length of bath is obtained. I have actually met with baths conforming to both of these designs.

The object of this scheme is to thoroughly soak the bagasse before recrushing and to allow the added water to thoroughly

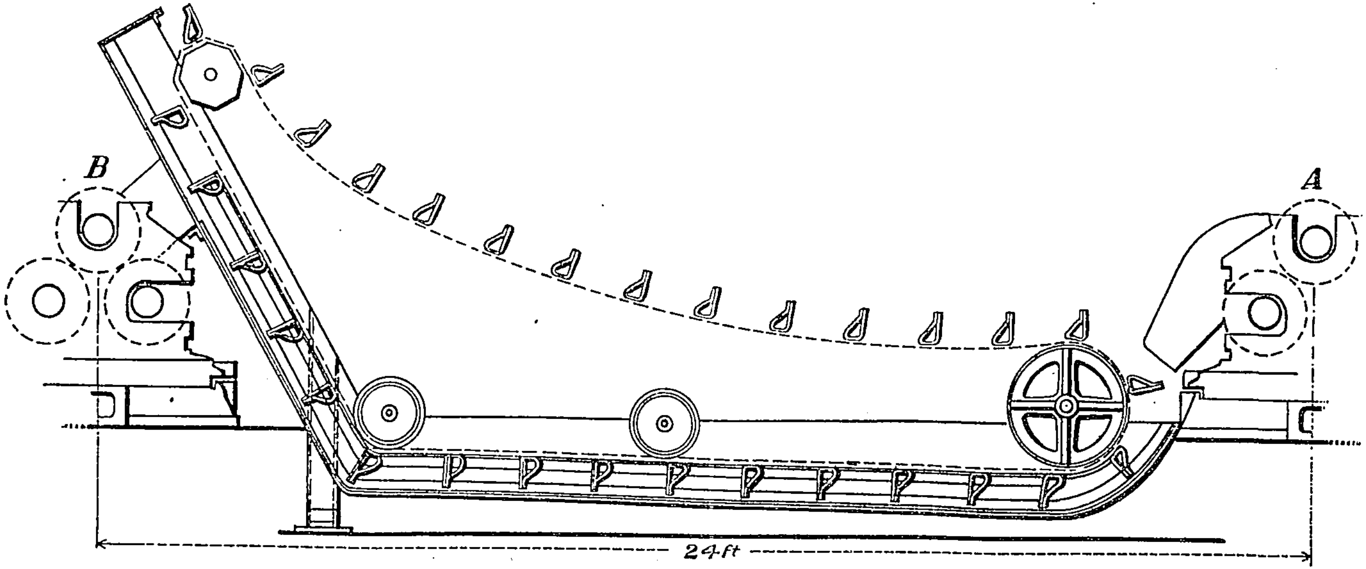

FIG. 1.

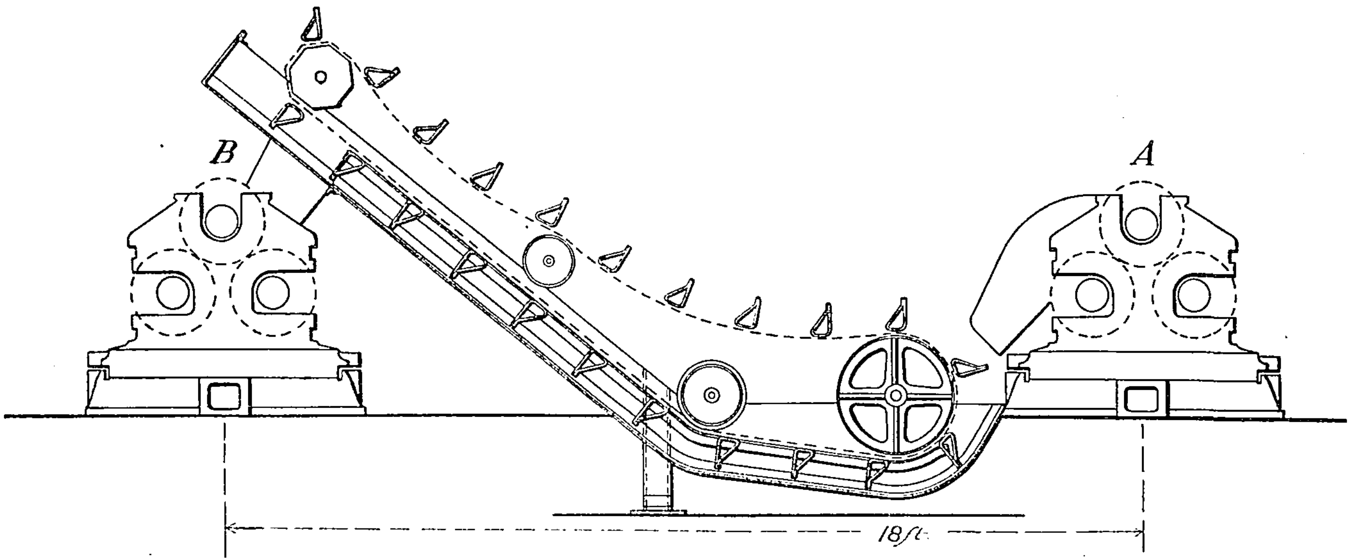

FIG. 11.

mix with the residual juice, and it will be found that the density of the juice discharging from the bath is from 1.5° to 2° Brix. higher than that entering.

These baths can be used in a variety of combinations. In a six-roller mill the diluted juice is returned from the second mill B by means of a pump. This juice may be discharged through a pipe running across the top of the inclined shoot, and immediately above this the added water enters through a second pipe; so far as influencing the dilution is concerned, the added water may mix with the juice on the mill bed, and on paper with complete admixture the effect is the same.

In another scheme a bath may connect the first and second mills only, and imbibition may be practiced between the second and third; in this case the diluted juice from the third mill goes into the bath, and juice is taken from both overflow and mill bed.

In other cases baths may connect all the mills and the systematic complete return of the expressed juices from mill to mill may be practiced, the juice from the first mill and the overflow from the bath connecting the first and second mills passing on to the boiling house.

These baths are in use in Mauritius, in Fiji, and in Australia; but I do not believe elsewhere; my experience of them is briefly as under.

On arriving in Mauritus as chemist to a firm controlling a ~~number of mills in that island, I received orders to go to a cer-~~ tain mill and make a series of comparative tests of the results obtained with maceration and imbibition.* The results obtained were much in favor of maceration; the executive on the strength of these experiments gave instructions that maceration was to be used, and I had no more opportunity of making comparative tests.

Afterwards I was able to gather from the literature of the sugar industry that these baths were not in use in Java and in the Hawaiian Islands, the two districts to which I looked for progressive ideas. I was then unwilling to give the same weight to the short trials I had made as to the accumulated experience of engineers obtained elsewhere; latterly, however, I have met at least three thoroughly competent engineers who have expressed themselves dissatisfied with present arrangement on the grounds that the short distance from mill to mill does not give the water time to soak into the bagasse.

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* By maceration I mean here the use of baths and by imbibition the spraying of water on to the bagasse as usually followed in these islands; it is by these two terms that the schemes are distinguished in Mauritius.

The present arrangements of mill gearing used in these islands gives a compact train of mills and leaves no room for the insertion of a bath. Most of the plants that I have seen were composite plants, each mill having its own motor, and the distance from mill to mill varying from 18 to 30 feet; one plant, however, a six-roller mill, had its gearing arranged as seen in plan in *Fig. 3*† whereby room for a bath is obtained. The twelve-roller mills in these islands, and I believe elsewhere, all employ two motors, and I am still inclined to believe the most efficient sugar extracting apparatus would be a twelve-roller mill and crusher consisting of two six-roller units with the train of gearing arranged as in *Fig. 2*, and with sufficient room between each unit for the insertion of a bath between the second mill and the third mill.

In discussing these baths with some engineers in these islands, two at least have told me that the transmission of power through worm and wheel gearing would be a highly efficient means, and would enable the mills to be placed any distance apart; this same opinion I have also heard expressed by another highly competent engineer elsewhere.

NOEL DEERR.

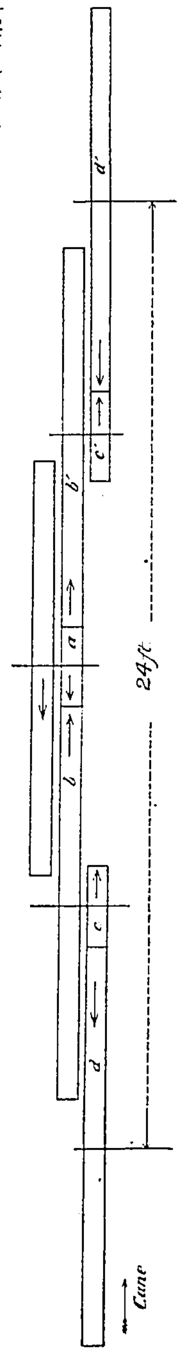

FIG. III.

† In Fig. 3, a represents the first motion pinion; b and b' the first motion spur wheels; c and c' the second motion pinions; and d and d' the second motion spur wheels, the centers of which form also the centers of the mills. The drawing is made to a scale of 1-64 and gives 25 feet as the distance between the centers of the mills. The ratio of gearing is approximately 20:1 in the first mill, and 19:1 in the second mill. The cut of the "Pratt Imperial Mill" at present appearing in the advertisement pages of the *Louisiana Planter* shows a train of gearing of this type. Gearing arranged in this "open form" is also to be seen in the mill of the Hawaii Mill Co. at Hilo, and I believe also at McBryde.

THE ENTOMOLOGICAL WORK OF THE HAWAIIAN SUGAR PLANTERS' ASSOCIATION AS SEEN BY DR. SILVESTRI AND MR. FROGGATT.

With Notes by G. W. Kirkaldy.

The Hawaiian Planters' Record.]

In the August number, I briefly adverted to the comments made by Mr. Froggatt of New South Wales, (in a special official report*) on pests and parasites in the Hawaiian Islands.

Dr. F. Silvestri, the most eminent of the Italian entomologists, who stayed here, a year or so ago, for about a month, has now published a lengthy "Survey on the Actual State of Agricultural Entomology in the United States of North America." This has been roughly translated into English in the August number of the *"Hawaiian Forester and Agriculturist"* (Vol. VI, 287-336), and I think it is interesting to compare what Dr. Silvestri has to say on some of the matters about which Mr. Froggatt has already unburdened himself.

Dr. Silvestri's report is very valuable and should be read right through. I have selected only those parts which bear on what Mr. Froggatt has written about these Islands and this Experiment Station.

It may be useful to recapitulate briefly some of the facts of Mr. Froggatt's visit:

Mr. Froggatt was appointed by a conference of Australian government entomologists held in Sydney in 1906, to represent them in a world tour with the object of making thorough enquiry into the subject of pests and parasites. He arrived here on July 14, 1907, leaving about the middle of August.

When, in a few days, he visited this Experiment Station, I at once offered to place Mr. Terry or Mr. Swezey, or both of them, at his disposal for a thorough entomological investigation of any of the plantations, as I naturally concluded that he wished to form an unbiased opinion from his own observations. Mr. Froggatt declined the offer, owing to "lack of time," a curious reason considering that the object of his journey was, supposedly, to obtain all possible information on pests and parasites, and considering that the Hawaiian Planters' Experiment Station had just successfully completed pioneer experiments on a large scale which (at that time, at least,) he would not have been able to find duplicated anywhere else in the world.

Mr. Froggatt's visits to the Station were few and brief, and were almost entirely occupied by an examination of our Australian

* "Report on Parasitic and Injurious Insects, 1907-1908"; New South Wales, Department of Agriculture, 1909. The title on the cover is "Official Report on Fruit Fly and Other Pests in Various Countries, 1907-1908."

type collections. A large proportion of his time was spent on Molokai where there are no sugar plantations.

The great difference in the thoroughness of the investigations made on the one hand by Mr. Froggatt and on the other by Dr. Silvestri, is apparent on referring to the comparisons below; in smaller type are Mr. Froggatt's meagre, general criticisms; while in ordinary type are contrasted Dr. Silvestri's detailed personal observations.

The courtesy shown and trouble taken by the staff of the Planters' Experiment Station has been very poorly repaid by Mr. Froggatt, whose animus against the Association and its Experiment Station is very obvious.

It is difficult to understand how Mr. Froggatt could have honestly presented such a misleading report, as his expressed conclusions are directly contradicted by the people whose interests are most at stake, the Hawaiian Sugar Planters, who have expressed their complete satisfaction with the results, so far, of the natural campaign.

The text in the "Forester" has been followed except in a few instances where it has been altogether too poorly expressed.

Froggatt.

Honolulu was reached on the 14th of July, where I remained for three weeks. During that time I placed myself, first, in the hands of the Federal Department of Agriculture; Mr. Jared Smith is Director, and Mr. Van Dine, Entomologist; and most of my official work was done at the Experiment Station, with the assistance of these gentlemen.

Besides the United States Department of Agriculture, there are at Honolulu two other institutions at which entomological work is carried out—the Experiment Station of the Hawaiian Sugar Planters' Association, where, under the director, Mr. R. C. L. Perkins, there are six other entomologists in the Entomological Division. The staff carry out investigations in the control of the pests of sugar cane, and, therefore, do not pay any attention to fruit-flies or orchard pests. Messrs. Perkins and Kirkaldy have been for some time describing new species of all kinds of insects, which in many cases have little to do with economic entomology or pests of sugar cane, though they form a fine set of monographs of the insects dealt with, obtained by their collectors.[1]

Silvestri.

"* * * For the same purpose (inspection of live vegetable imports) principally, the Territorial government of Hawaii maintains an entomological station at Honolulu with three technical employees. * * *

Before closing the enumeration of laboratories I wish to record that in Honolulu besides the Territorial laboratory with three entomologists, and the Agricultural Experiment Station with two entomologists, there exists also a private one forming

[1] How is Mr. Froggatt able to determine which insects will, or will not, prove in the future to be pests? There is no insect which is not, or may not be, connected with economic entomology, and our experience with *Perkinsiella saccharicida* and the gonatopid parasites of *P. vitiensis*, and the impossibility of finding accurately determined borers in the European museums, has shown—what indeed every instructed entomologist knew before—the importance of keeping together the biologic and systematic aspects of entomology.—G. W. K.

part of the experiment station of the Hawaiian Sugar Planters' Association. This laboratory has six entomologists, among them the most able systematist, Dr. R. C. L. Perkins, and Albert Koebele, the ablest seeker of insect parasites. This one costs annually not less than $28,000 and keeps even now two traveling entomologists, one in Europe and one in Malaysia, for the purpose of collecting insect parasites. It also publishes an interesting bulletin of which the second volume has just been completed.

With this last admirable example of what enlightened private associations also undertake in order to be prepared to combat injurious insects, I believe I have enumerated almost all the institutes and laboratories which are occupied in the United States with the safeguarding of extremely rich and varied agricultural productions from the attacks of hostile animals. In summing up I will state that about 200 persons are occupied there in agricultural entomology and that federal and state governments spend for the maintenance of laboratories in the neighborhood of $800,000. If we add to this what the state of New Jersey and other states spend for the extermination of mosquitoes, we arrive at the enormous sum of $1,200,000. * * *

The method of control is called natural when other living beings are used to fight injurious insects. Of these, however, up to now insects alone are known, and very partially at that, to be effective.

Whatever has been attained up to now with the natural method is due to experiments undertaken and carried through in some cases with good results, especially in the United States (mainland) and the Hawaiian Islands. I therefore believe that it would be useful to add to this treatise an account of what has been accomplished in these countries; also what little has been practiced elsewhere following their example. Thus one will get an idea of what has been done in this field and will also be able to understand how much may and must still be tried with prospects of good results.

Facts which make the natural methods advisable. It has always been very obvious to anybody, seeing one insect devour another, that injurious insects must also, at least in part, be devoured by other insects, properly called predators.

Acute observers, naturalists and specially entomologists who make a study of insect life, have since remote times had occasion to notice that often from the egg or from the chysalis of a given insect not an individual of the same species is born, but one or more individuals belonging even to different orders, so that from the larva of a given species instead of passing through the consecutive stages peculiar to it, at a certain moment of its development, larvae of other insects appear because the former has been killed by these larvae of other insects, who devour it from the inside or suck it dry from the outside. These are the parasitic insects, which have been noticed since remote times, and of which the internal ones have been called "entophagi" by Rondani, and the external ones "ectophagi" by myself.

Froggatt.

It is under the direction of this Experiment Station that some daring experiments have been made in economic entomology. Among these may be instanced the introduction of *foreign pest insects* to destroy introduced injurious vegetation. Much of the waste land of the Hawaiian Islands, denuded of its indigenous forest flora at a very early date, is now overrun with a low scrub of lantana, guava, and a prickly acacia. The planters claimed that it was too expensive to clear these lands of lantana, and Mr. Koebele spent a season in Mexico, collecting any insects breeding in or upon lantana. He sent over several microlepidoptera and small butterflies, whose caterpillars feed upon the flowers, foliage, and seeds; a gall-making fly (*Entreta sparsa*, Wied.); a leaf-mining fly (*Lithocolletis*, sp.) a defoliating leaf-bug (*Teleonemia scrupulosa*), and moth and beetle-larvae to devour the roots of the unfortunate plant. It was claimed that within about two years the lantana had not only been checked by the destruction of its seeds, but that it was dying out in large areas all over the islands. I examined a great deal of this scrub on the slopes of Mount Tantalus, and other places on which these pests had been liberated, and though the seeds were not so plentiful as upon the other side of the island, none of the plants were dead. However, upon the poorer land some plants had lost a good many leaves through the action of the plant bugs.

The Mealy Bug pest (*Orthesia insignis*), one of the most injurious pests to the tea plant in Ceylon, was accidentally introduced originally, it has been purposely scattered over the islands by the planters,[2] and may some day become a very serious pest to cultivated plants. Whatever may be said in favor of introducing insect parasites to destroy injurious insects, nothing, even if successful, can be said in favor of knowingly introducing plant-eating insects and their larvae, for no one can tell what such insects may do when their own food-plant is finished.

Silvestri.

The Lantana (*Fam. Verbenaceae*) was introduced in Hawaiian Islands from Mexico in 1858 as an ornamental plant, but favored by climate and lack of enemies, it was disseminated everywhere by the Indian Mynah bird (*Acridotheres*), which was imported to Hawaii for the destruction of caterpillars and found also Lantana seed to its liking. Gradually it took possession of districts which were used as natural pasture on the plains, hills and mountains, and became very troublesome to remove from cultivated land, especially sugar land. About 1900 it constituted a really serious problem for Hawaiian agriculture, but fortunately Koebele was then entomologist in the Islands, and he in this instance also had a happy idea, namely, to go to Mexico, study there the insects that live on lantana, and send them alive, without their enemies, to Hawaii, convinced that if the causes inimical to lantana prevented it in Mexico from overrunning territory so as to become injurious, at least some of the same inimical causes (the insects) taken to

[2] This is a serious misstatement. *Orthezia insignis* was scattered over the Island of Maui by the ranchmen (not, of course, the planters) against the repeatedly urged advice of the entomologists.—G. W. K.

Hawaii without their parasites would probably hinder much the development of lantana.

Koebele at once received the necessary means and went to Mexico in 1902 where he collected many living insects on various parts of the plant and sent them in repeated shipments to Honolulu. There Dr. Perkins took care of the material sent by Koebele and raised specimens of the various species. Of these the following are known with certainty to have become acclimated: *Agromyza* sp. (Dipteron), *Pterophorus* sp., *Lycaenidae,* two spp., *Lithocolletis* sp. (Lepidoptera); *Teleonemia lantanae* (Hemipteron).

The larva of *Agromyza* lives in the lantana seed, which is gradually destroyed by it.

The Lantana fruit attacked by *Agromyza* differs in appearance from the unaffected by being smaller, hard and remaining attached to the stem, while the others are soft on the outside and fall to the ground at once. *Agromyza* has multiplied to such an extent that it is now difficult to find lantana plants with healthy seeds.

Pterophorus lives in the larval state in the lantana flowers, which are in appearance small, atrophied and dark of color. It buries itself in the base of the flower, which it enlarges a little, destroying that part which should serve for the development of the seeds. This species and two following ones are now quite common.

The Lycaenid species deposit their eggs on the young blossoms of the lantana and their larvae destroy flowers and young seeds.

The four above named species are all given to the destruction of the flowers and seeds of lantana and thereby prevent its further dissemination. *Lithocolletis* on the other hand bores galleries in the leaves, and *Teleonemia* sucks leaves and flowers. The latter two insects defoliate the lantana plant several times during the year and to these is added the draining work of a scalebug, *Orthezia insignis* Dougl., which was not introduced by Koebele, the time and manner of its importation being unknown.

The result of the introduction of these and other insects, including a Dipteron that produces galls on the branches, has been to arrest the diffusion of lantana in the Hawaiian Islands and to have it now loaded with so many enemies that they finally must gain complete control, agriculturally speaking.

When in September, 1908, I went from Honolulu to the neighboring Mount Tantalus, I had occasion to see everywhere on the sides of the mountain before arriving at the native forest, more or less extended areas completely overrun by lantana, which was almost entirely without leaves and without flowers. Elsewhere I observed the same thing.

This ingenious idea of Koebele was also in this case a complete success and will lead to other good results in similar cases.

This method presents very grave danger, to avoid which exceptional and able caution is necessary because only such insect species must be introduced as have very specialized habits, like the *Agromyza* and *Pterophorus,* which almost certainly will not be able to adapt themselves suddenly and produce the same changes in plants of other species.

But when it is a question of insects which eat or mine the leaves, or sucking insects, prudence demands a very accurate study because it might happen that they, when transported to other regions, would adapt themselves to other plants and then it would become necessary to have recourse to the introduction of their parasites with much probability but without certainty of their efficacy in the new home.

In Hawaii none of the species introduced by Koebele has invaded other plants than lantana, only specimens of *Teleonemia* have been seen on some local plant, but without staying there long reproducing; therefore I repeat, for the present Koebele's success in the fight against a plant which has become injurious has been also complete.

Froggatt. This Association has sent officers all over the world to collect and send back parasites of all kinds, and according to the reports that have been furnished to the public, there should now be no scale insects or other pests in the Hawaiian Islands. Yet I found as many scale insects upon their cultivated plants as would be found in Australia, and also many cosmopolitan pests, such as Fuller's rose beetle (*Aramigus fulleri*) * * * *

The officers of the Sugar Planters' Experiment Station may have had other successful introductions such as ladybird beetles, to eat up mealy bug and other scale; but many of the ladybird beetles have in turn died out, while scale is quite common on trees and plants.

Silvestri. *Icerya* (Cottony Cushion scale) was introduced to the Hawaiian Islands in the vicinity of Honolulu in the spring or summer of 1889, probably with fruit from California and was observed for the first time in September of the same year. In April, 1890, its damage was noticed for the first time, whereupon A. Jaeger wrote to California for examples of *Novius* which were sent to Honolulu, where they arrived in good condition and multiplied so well that in November of the same year Jaeger was not able to find any *Icerya* to feed the *Novius* which he was raising in cages. In September, 1908, I also was able to ascertain that *Icerya* had become a real entomological rarity in the surroundings of Honolulu.

* * * * *

The success of the introduction of *Novius* as has been seen has been surprising in all the regions where it occurred as well in California as in Florida and the Hawaiian Islands, Cape Colony, Portugal, Italy, Syria, Egypt, and has saved many millions to these countries because without *Novius cardinalis* the raising of citrus fruit would have become impossible.

The reasons for this success beyond all expectation are due to three favorable circumstances which are: (1) *Novius* can produce in one year double the number of generations of *Icerya*. (2) *Novius* feeds with preference on eggs of *Icerya* when such are available. (3) The absence of insect parasites which in their turn attack *Novius* in countries where it has been imported.

Such an excellent result has as yet not been repeated by any other insect, but other good results have already been obtained in other cases as will appear from all the attempts I shall record.

Scutellista was introduced by Craw into Hawaiian Islands in 1905 and there too it became so well established that I, desiring to collect near Honolulu *Lecanium oleae* parasitized by *Tomocera* to carry them to Italy, could not do so, because in a locality where a certain number of specimens of *Lecanium* had been found, which was in the hedge of Dr. R. C. L. Perkins' garden, all adult specimens instead of being parasitized by *Tomocera* had under their body the larva of *Scutellista*.

In Hawaii *Lecanium* is attacked by two other imported hymenoptera, viz: *Encyrtus fuscus* and a *Coccophagus*.

* * * * *

Later Koebele introduced *Cryptolaemus* also into Hawaii where it has resulted in the greatest advantage, not inferior to that of *Novius*. Before its introduction oranges and other plants (among them sugar cane and coffee) were much invaded by *Dactylopius* (*D. albizziae* Mask., *calceolariae* Mask., *citri* Risso, *filamentosus* Cock., *bromeliae* Bouch., *virgatus* Cock., while now they are almost free, as I myself could observe. From China and Japan Koebele introduced into Hawaii another coccinellid (*Sticolotis punctata*) predatory on *Dactylopius*. In Hawaii there is now *Pseudococcus* (*Dactylopius*) *nipae* Mask., widely distributed on various plants, because it is only seldom attacked by *Cryptolaemus* and only in winter by *Rhizobius ventralis*.

* * * * *

Pulvinaria psidii has been very harmful in Hawaii; Koebele, after a visit to the coffee plantations in 1894, wrote that he had never seen trees blackened so much by smut, which had developed on the sugary excreta secreted by *Pulvinaria*, while three years later he found the same locality almost freed by *Cryptolaemus* which had attacked *Pulvinaria*, destroying its eggs. Also the chalcidids, *Microterys flavus* How., and another not determined species, destroy this *Pulvinaria*.

Pulvinaria mammeae is also attacked in Hawaii by *Cryptolaemus*, by *Novius cardinalis* and by *Hyperaspis*.

Finally *Cryptolaemus* has proved a most efficacious predator and, in Hawaii, as useful (if not, as some say, more so) than *Novius cardinalis*.

I have taken living *Cryptolaemus* from Hawaii and from California and have distributed them at Capri, Ischia, Palermo, Portici, in citrus orchards infected by *Dactylopius citri*, which, although it has a number of parasites in our country, frequently becomes very harmful.

Ceroplastes rubens, a species of Asiatic origin, was up to about 1895 very common in Hawaii, but Koebele succeeded in finding in China and sending to Honolulu various hymenopterous parasites of which at least four have become acclimated.

In 1900 *Ceroplastes rubens* had become rare.

* * * * *

In the Hawaiian Islands Koebele introduced for the fight against *Diaspinae* the two species of *Orcus* mentioned, of which *Orcus chalyboeus* is sufficiently common on citrus trees, as I have had occasion to see, *Rhizobius lophantae* which often develops in good numbers at the expense of *Phenacaspis eugeniae* (Mask.) and later on (1896) from China *Chilocorus circumdatus*, Schoen., and *Platynaspis* (*Pentilia*) *nigra* Weis., which attacks specially *Lepidosaphes citricola*, besides some other *Diaspinae*.

Many other Coccinellidae to fight Diaspinae have been sent to Hawaii from Australia and China, but they have not become acclimated and have not yet been observed. From the first named country *Serangium maculigerum* has become acclimated with certainty, as I have been told by Dr. Perkins, who observed it in a mountainous part but without having had occasion to ascertain its victims.

Koebele very likely, but Craw with certainty, introduced (1905) from Japan also *Chilocorus similis*, Rossi. He raised it in a cage, but nobody seems to have observed it recently at liberty.

Also many Hymenopterous endophagi of Diaspinae have been introduced into Hawaii by Koebele from Australia and China, but reliable data about them are up to date not available.

In the Hawaiian Islands, where the result of such introduction can be much more easily noticed than in California, it may be said that the Diaspinae are attacked by all the predators and endophagi in such a manner that citrus and other plants are generally only to a small degree infested by them. But in some localities I saw trunks of citrus trees almost completely covered by *Lepidosaphes*, though larvae and adults of *Chilocorus circumdatus* were already preying upon them. I also saw in abundance *Phenacaspis eugeniae* on *Nerium oleander* and without predatory or endophagous insects.

It must be recognized, however, that if the result of fighting Diaspinae has not been the best even in the Hawaiian Islands, since trees which are badly infected by them are still to be seen, nevertheless it is pretty good, as most of the time there is no absolute necessity for fighting artificially any species of these scalebugs, which number about thirty or more.

In Hawaii on the other hand *Coelophora inaequalis* also introduced by Koebele, has given excellent results. It has propagated there rapidly, and wherever aphids appear it does its beneficial work. I have been able to see for myself in a garden a small bed of beans infected by *Aphis papaveris* with numerous individuals of that species, *Platyomus lividigaster,* and some *Scymnus notescens,* all intent upon the work of destruction. Dr. Perkins told me that of all the coccinellids introduced, he believes that in the Hawaiian Islands those which proved most useful were *Coelophora inaequalis* and *Cryptolaemus montrouzieri.*

C. inaequalis eats many species of aphids and also young larvae of *Perkinsiella saccharicida,* Kirkaldy; *Platyomus lividigaster* is more common now in Hawaii than in Australia, its original home.

More recently Koebele introduced also *Coelophora pupillata,* Schoen., which has become acclimated here, feeding on Aphids and *Aleyrodes.*

One species of *Aleyrodes* was formerly very common in Hawaii on coffee plants and very harmful, but has now become so scarce that Kotinsky in 1907 could not find specimens for description. This extraordinary diminution is attributed to various parasites introduced by Koebele, but their names are not known.

We have seen what excellent results in fighting *Icerya* have been obtained everywhere, with the introduction of *Novius cardinalis,* how efficacious has proved *Cryptolaemus montrouzieri,* especially in the Hawaiian Islands in checking the development of various species of *Dactylopiines,* not to speak of how useful proved also in the Hawaiian Islands the introduction of *Coelophora inaequalis* in destroying the numerous aphids which destroyed many plants.

Such examples are certainly finely demonstrative, but also appear simple and their solution could not require very special ability once the principle was recognized of the possibility of finding useful parasites against harmful insects, as for instance *Icerya* in its home country.

Froggatt.

One of the greatest successes of the Association was the introduction of a parasitic wasp that destroys the eggs of the very destructive cane-leaf hoppers (*Perkinsiella saccharicida*). This hopper was introduced into their cane-fields about 1902, and caused an immense amount of harm, by depositing its eggs in the midrib of the leaves and sucking the sap out of the stems, causing injuries that produced a great deal of smut upon the surface. This caused a great loss where the fields were badly infested; and Professors Koebele and Perkins came over to Queensland in 1904, and spent some months collecting parasites in the northern cane-fields, from whence the hopper had probably been brought. Koebele sent back quantities of several species, one of which became established in the experimental cane growing round their laboratories, and from there was scattered all over the islands. When I was there last year (1907) there were plenty of hoppers in the different fields we visited; but there were also many eggs in the midrib of the leaves, some with parasites and just as many uninfested. So rapid, however, was the spread of this egg parasite over the islands in about two years, that one would almost think the parasite had been accidentally introduced with the cane-hoppers in the first instance, and had only made its appearance evident after the artificial introduction. This, however, would not lessen the credit that attaches to Koebele's work.

Another thing they do not take into account is, that when the leap-hopper damage became acute, the methods of cultivating the cane were altered in many places; the refuse (probably containing many eggs and larvae) was burnt instead of being buried, and new varieties of cane, with more resistant powers to the attacks of the leaf-hoppers, were grown in the infested fields.[3]

Before we finish with this insect problem, I would point out that these leaf-hoppers must still exist in considerable numbers; so much so, that when the Pure Food Act came into operation in the United States, just before I arrived at the islands, it was stated that some of the Hawaiian honey was not up to the standard demanded by the chemists. This was a very serious matter to the ranchmen, for nearly all of them ran apriaries on their estates, particularly the American Sugar Company, who have an estate of 95,000 acres on the Island of Molokai, where they have some thousands of hives.[4] The chief flowers from which the honey is obtained are those of the algaroba tree, which forms great thickets all round the coasts and in the valleys between the mountains. This tree (*Prosopis juliflora*), said to have been introduced from Mexico, is identical with, or closely allied to, the species of this genus known as the "Mesquite," and bears a great crop of slender beans that are very good cattle and horse food.

This is known as "Algaroba Honey"; but about two-thirds of the crop is an abnormal dark production, which is now known as "Honey-dew Honey." This is produced by the bees collecting the honey-dew exuded by the swarms of leaf-hoppers and aphis in the cane-fields. Van Dine says (Bulletin 17, 1908): "The increase in the production of Hawaiian honey in recent years corresponds with the advent of the introduced sugar-cane leaf-hopper into the cane-fields, and the present extension of

In fact, it would be as difficult to enumerate all the pests that have been accidentally introduced from abroad as it would be to list the purposely introduced more or less useful insects that now form the bulk of the insect fauna of the islands.[5] Even most of the birds commonly met with are introduced, and mostly pests; such as the Rice Bird (*Munia risoria*, var. *punctata*), and the Indian Minah (*Acridotheres tristis*).

There is an introduced rat that damages the sugar-cane and the mongoose was introduced from India to destroy it; but the mongoose has, contrary to expectations, destroyed most of the ground-nesting fauna on the islands except rats, and no one now can keep poultry in the immediate vicinity of Honolulu except in closely-netted yards.[6]

In the case of *Cryptolaemus*, *Coelophora*, and *Platyomus*, Koebele demonstrated also how it is possible to fight with insects parasitic of species of a certain region, insects of related species or of other genera native of other countries, and therewith instituted another noteworthy step in the natural method of control, but still he had to

Silvestri.

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[3] This is another serious misstatement. It has been the almost universal custom in Hawaii for the past quarter of a century, or more, to burn the cane refuse.—G. W. K.

[4] The value of Mr. Froggatt's observations is shown by the fact that there are no sugar cane plantations on Molokai.—G. W. K.

the business is in the vicinity of the immense areas of land given to cane culture."

[5] This is a palpably ridiculous statement. The purposely introduced insects form a very small proportion of the insect fauna of the islands.—G. W. K.

[6] Many of these remarks are made by Mr. Froggatt in scarcely a fair spirit. The impression left on the reader is that the mynah bird, rats, and mongoose, were introduced recently by the scientific staff of the Planters' Association at the same time as the leaf-hopper parasites, ladybirds, etc., whereas Mr. Froggatt knows very well this is not the case. Mr. Froggatt all through seems to confuse together natural immigrants and purposely introduced forms.—G. W. K.

prove to the world how much confidence can be placed in the auxiliaries offered by nature.

In this new case he needed the efficient assistance of a profound connoisseur of insects of every group, of a diligent and patient collector, observer and breeder, that is of Dr. R. C. L. Perkins, as well as an able sytematician of Hemiptera, Kirkaldy.

The occasion for this new and great experiment, which to relate gives me great pleasure, was offered by *Perkinsiella saccharicida*, Kirkaldy, a Hemipteron of the family Asiracidae (Fulgoroidea).

This *Perkinsiella* is a small insect four to six millimetres long. It deposits its eggs in or near the mid rib of the leaf and also on the stem of sugar cane. The larvae and adult live on the juice of the cane. The damage it does is direct and indirect; the first is caused by the deposition of the eggs and the subsequent openings made by the larva which has to work its way through the epidermis, and by the abstraction of nutritive liquids caused by the larvae and the adult. The indirect damage is due to the smut and other fungi which develop on the cane plants in excrementa of *Perkinsiella*, which contain sugary substances.

In the case of serious infection, if the cane plants are small they may be completely destroyed, if they are well enough advanced they lose many leaves, do not reach complete development, and yield a crop smaller of course in proportion as the damage is greater.

Perkinsiella saccharicida was seen for the first time by Perkins who collected several specimens, but not until the end of the year 1901 or the beginning of 1902 was it found harmful to sugar cane on the Islands of Oahu and Kauai. In the month of November, 1902, Perkins wrote: "This little insect is very injurious to sugar cane and its destructive activity threatens to surpass that of the insect which bores galleries in the cane (*Sphenophorus*)."

The subsequent events happened briefly as follows: On all the sugar plantations *Perkinsiella* spread rapidly causing such enormous damage that Van Dine calculated it in 1903 to amount to $3,000,000. Naturally alarmed the sugar planters pressed the entomologists of the Territorial government to find a way of fighting this fearful pest, which had it continued would have compelled them to relinguish the most remunerative industry of the islands.

Fortunately Koebele and also Perkins were there, both enthusiastic for the natural method of control, the only one they could consider in the present case.

Koebele having heard of the presence of parasites of Fulgoroideae in Ohio, went there in 1903, collecting many species, of which he succeeded in raising in cages, using *Perkinsiella* as host, two hymenoptera of the family Dryinidae (*Hoplogonatopus mexicanus* and *Pseudogonatopus*, sp.).

These were liberated in the cane fields but no specimens were observed subsequently.

In the meantime Perkins sought to ascertain the original home of *Perkinsiella*, convinced that it was a recent introduction. At first he suspected that it was a species existing in Java (*Dicranotropis vastatrix*); but with the help of Kirkaldy, who obtained specimens of that species, he established the fact that such was not the case. He repeatedly applied to his correspondents in Australia, and finally, about the beginning of 1903, he received from Queensland several specimens of a Hemipteron which lived there on sugar cane, and which were exactly identical with those of the Hawaiian Islands.

Having therefore ascertained that *Perkinsiella saccharicida* was of Australian origin, the Sugar Planters' Association did not hesitate to accept the proposition to send to Australia in search of parasites of *Perkinsiella* and entrusted this task to Perkins and Koebele.

They arrived in Australia in May, 1904, and Perkins returned to Honolulu about the end of the same year after having visited together several parts of Queensland where they made very rich collections. Koebele went for another short time to the Fiji Islands in order to continue their collections, especially of Fulgoroideae and their parasites.

Perkins and Koebele gave themselves entirely to the collections of *Cicadoideae* and *Fulgoroideae* and their parasites, of all the species they could find, sending the largest possible number of specimens alive to Honolulu, where Craw took most diligent care of them.[7]

They collected more than one hundred species of parasites, of which the following became acclimated in Hawaii: *Anagrus* (two species or two races of the same species), *Paranagrus* (two species, *P. optabilis* and *P. perforator*), *Ootetrastichus beatus*. These species are all of prime importance because they are parasitic on the eggs of *Perkinsiella* and show their activity also in quite distinct parts of the leaf, thus *Paranagrus* prefers to parasitise the eggs deposited in the mid rib at the base of the leaf, *Ootetrastrichus* also those of the mid rib but in the high part of the leaf, and *Anagrus* the eggs in the leaf proper adjacent to the mid rib. These parasites have multiplied rapidly, but *Paranagrus* and *Ootetrastichus* are more common, because *Anagrus* parasitizes the eggs of other Fulgoroids besides *Perkinsiella*.

From only four individuals of *Paranagrus* which arrived alive at the end of January, 1904, at Honolulu, a very large number was obtained for delivery one year later on many plantations.

According to observations by Dr. Perkins about the end of 1906 from leaves with eggs of *Perkinsiella* which had been collected on a plantation, which before had suffered great damage,

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[7] This is a mistake. The material sent to Honolulu from Australia was, naturally, taken care of by the entomologists of the Planters' Experiment Station.—G. W. K.

3,275 parasites and 250 larvae of *Perkinsiella* were obtained in the laboratory, which means that 86.3% of the eggs had been destroyed.

Otto H. Swezey in a report of a visit to a plantation on the Island of Hawaii on April 10, 1906, wrote: "This pest [referring to *Perkinsiella*] has begun to become very much reduced in comparison with the last visit in December, 1905, but is still causing here and there serious damage. The egg-parasites are multiplying more and more and are distributed over the whole field wherever there are *Perkinsiella*.

One year later the same entomologist having visited the same plantation reported that *Perkinsiella* was almost entirely destroyed and that the parasites were as few as the hosts, but that they were to be found wherever there was *Perkinsiella* left.

Besides these species of egg parasites the following now attack *Perkinsiella*: *Haplagonatopus vitiensis,* collected by Muir in 1907 on the Fiji Islands; a *Pseudogonatopus* sp. sent by the same from China, and another *Pseudogonatopus* sp. which Koebele obtained in Mexico in 1908, from a species of the genus *Liburnia*, and which has adapted itself in Hawaii to parasitise *Perkinsiella*. Also species of *Dryinidae,* natives of Kauai and Oahu, *Ecthrodelphax fairchildii,* P., and formerly parasitic on other Fulgoroids, has adapted itself to *Perkinsiella* and has been distributed on all the other islands of the group. Of the predatory Coleoptera, *Verania frenata* and *V. lineola*, *Callineda testudinaria*, raised excellently in cages and distributed in large numbers, nothing certain can be said; the same applies to the numerous other parasites which arrived alive at Honolulu and which were collected in part on another voyage on which the Sugar Planters' Association had sent the Assistant Entomologist Muir to the Fiji Islands in 1906 and later on to China.

The practical result of the introduction and acclimatization of the imported parasites has been so good that all anxiety on account of *Perkinsiella* seems now dispelled and so it appeared also to me, having seen a number of parasites hatch from the eggs of leaves from different localities.

Only, the practice of burning the cane leaves in the fields kills many parasites while the *Perkinsiella,* being able to fly, can save themselves more easily and this hinders their reduction to a smaller number, but already the entomologists are studying to find a way to obviate this loss of help. Koebele and Perkins, as well as the Sugar Planters' Association, who furnished the means, may be well satisfied with the results obtained.

From a scientific point of view the results have been very good. It is a matter of hundreds of descriptions of new (*Hymenopterous*) parasites together with their hosts also largely new, and with the biological observations there has been added an excellent contribution to the knowledge of the families of Diptera (*Pipunculidae*) and *Coleoptera* (*Stylopidae*), which are little known and there has become known a new family of Lepidoptera (*Epipyropidae*) of singular structure and habits, which our knowledge of Australian *Cicadoideae* and *Fulgoroideae* and their parasites has been greatly enriched.

The major portion of the work on these insects has been written by Perkins and Kirkaldy and a smaller part by Terry, Swezey and Muir, who are entomologists of the Sugar Planters' Association laboratory; complete they form two volumes which I consider among the most important publications in our time on a subject of agricultural entomology, though it may now perhaps be equalled or even considerably surpassed by what is being achieved in the United States in regard to *Lymantria dispar*, L., and *Euproctis chrysorrhoea*, L., under the direction of Prof. L. O. Howard.

Omiodes accepta is a species of moth of the family *Pyralidae*, native of the Hawaiian Islands, which in the larval state injures the sugar cane by folding the edges of the leaf against each other and eating parts of it. The harm done by it may at times become quite serious.

This Lepidopteron had been attacked by several species of indigenous parasites but Koebele introduced several others besides, of which *Macrodyctium omiodivorum*, Terry, is the most important, having destroyed alone as much as 75% of larvae in one locality. The year of introduction and origin of this species are not known with certainty. *Chalcis obscurata* Walker, was introduced in 1895 from Japan and in 1896 from China and spread rapidly in the Hawaiian Islands, parasitizing besides *Omiodes* other Lepidopterous pupae (*Phlyctaenia, Cacoecia, Plusia, Tortrix*); *Trichogramma pretiosa* Riley, a North American species, was also introduced, perhaps about 1898, by Koebele and is now well spread, destroying eggs of various species of Lepidoptera, including those of *Omiodes*.

With this experiment it has been demonstrated for Lepidoptera as it has been for Hemiptera, that it is possible to acclimatize and adapt in a certain country species of foreign parasites which in their original home parasitise other species, even of different families.

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[We may now see what are Dr. Silvestri's conclusions]:

I have briefly set forth the actual organization of agricultural entomology in the United States, the methods of fighting used there and the results, and I believe it to be just to acknowledge that much has been accomplished in that country, much more perhaps than in all other countries combined; nevertheless, notwithstanding the number of persons occupied with agricultural entomology, notwithstanding the favor with which their advice is accepted and put into practice, it is known, from an approximate calculation by Mr. Marlatt, vice director of the Entomological Bureau of the Department of Agriculture, that the annual loss due to the work of insects amounts in the United States to a sum of seven hundred million dollars!

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We have to deal here with an enormous sum which many will at first perhaps consider greatly exaggerated but, if they will examine industry for industry and take the difference between the crop that might be had and the actual crop, even with the present cultural methods, they will find that this sum falls perhaps behind the truth.

It is a real fact, I believe, however painful it may be that the majority of agriculturists have been used for years to see crops reduced by one insect or another and that they have become reconciled to such losses believing that there is no way of preventing them.

On the other hand it would be well if our farmers could be convinced that up to date agricultural economy, if provided with sufficient personnel and means, is in the majority of cases in a position to devise if not perfect methods at least such as are apt to diminish the injury caused by insects. There will be cases in which the entomologists will not be able to propose in a short time sure and practical methods of fight; but I believe that it is hardly possible that after prolonged, profound and conscientious study of a given question and with all the means at hand, they will not arrive at some practical result. Our agriculturists should have the greatest confidence in science, because it can always return a hundred fold what it receives, but at the same time they must support it with their good will as well as with their means; it is in this that they are now lacking in our country, and the consequence of this lack (and not of willingness and genius) is the lack of persons who can give their whole lives to the study of pure and applied sciences.

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As for the natural fight, finally, it must be stated that in the United States it has already produced some excellent and some partial results; that in Hawaii it has been applied with very good results in most cases; that in Australia it has already produced beneficial effects and that better ones are to be expected in the near future.

It is necessary that the agricultural entomologists should seek to introduce from other continents not only the parasites of the imported species, but all those of indigenous species and of species and families related to the indigenous ones.

Everything possible must be tried with the confidence that in some case the best results will be obtained.

I have said before that it is necessary to know the biology of indigenous parasites in order to appreciate as much as possible those which are most useful for the natural fight and in order to also multiply them when possible, but having to deal with forms which in our country have numerous methods of damage, we may perhaps never succeed in limiting these, if at all only very partially, while by introducing and acclimating a foreign primary parasite without its secondary parasite or parasites, we can maintain a continuous and very effective natural fight against certain insects.

The natural fight must always be maintained with the greatest confidence and since it requires only one expense during the studies and necessary researches for one or a few years, while its result may be the best and continuous, it must be abandoned only after all possible trials have failed.

In order to be able to apply the natural fight, the most profound biological knowledge of the insects to be fought and of their parasites is necessary because the cases are few in which matters are as simple as in *Icerya* and *Novius*; therefore the institution of a large entomological section near the Ministry of Agriculture is more than ever necessary.

Special surveillance should be exercised over plants imported by nursery men. These are the principal if not the sole introducers of injurious insects and fungi even from the most distant regions as they are also the principal propagators of such misfortunes in one and the same region. In fact, in order to be able to offer to their customers new varieties of species of fruit or ornamental plants, these people frequently send for small plants to any country and with these they may introduce diseases which are at present unknown. In the nurseries the insects (or fungi) then find an environment congenial for their development and multiplication and when the little plants are sold their enemies go with them.

With this last wish for an inspection and disinfection of plants imported from abroad, which I formulate after the example of that which I have seen vigorously enforced in the ports of San Francisco and Honolulu, I have finished my account and take leave of you, thanking you for having listened with such great indulgence and recommending that you may keep in mind that in order to safeguard the agricultural industry of Italy it is necessary that applied entomology, as well as plant pathology, should be held in the highest esteem because to improve or innovate methods of cultivation is of no value if a better knowledge of plant enemies, which would permit of finding proper means to defend the greatest wealth of our country, does not keep even step with it.

The example of the United States of North America may serve us as a guide and stimulus!

BRITISH GUIANA EXPERIMENTS.

The following is taken from the Agricultural News and is interesting as showing the results of sugar cane experiments in British Guiana:

The report of the Sugar-Cane Experiments Committee, Board of Agriculture, British Guiana, 1908, deals with the results of the cultivation of varieties of cane on sugar plantations in British Guiana during the two crops of the year ended December, 1908. The information included in the report is obtained from the results placed at the disposal of the Board by thirty plantations on which variety trials were being made. It has reference to the yields of commercial sugar from the different varieties of cane; the distribution of the varieties between the estates whose results were available, together with a comparison of their yields; the differences in yields resulting from those in soil and meteorological conditions; a comparison of the yields in the earlier and later months of the year; details of the data of results obtained on areas of not less than twenty acres on any estate; similar information to that which has been detailed, for the years 1901 to 1908; opinions as to the milling qualities and the fuel value of the megass of the different varieties; and information in regard to the suitability of different varieties to different soils, as well as to the signs of deterioration that are becoming evident in some cases.

In regard to the results from the thirty-five plantations, it is shown that the Bourbon cane occupies by far the greater acreage, followed by D.625, D.109, and B.208. The returns showing the average yield of commercial sugar in tons per acre for each variety place B.376 at the head, followed by Green Transparent (Selangor), D.625 and B.208. D.625, Bourbon and D.109 lead easily in the matter of the number of plantations from which reports are made concerning them, and of these D.625 has shown the largest number of instances of highest and second yields. On the different estates, as regards the yields of tons of commercial sugar per acre, D.625 is always among the first three, D.145 among the first five, and D.109, B.147, B.208 and Bourbon among the first six, varieties. D.625 showed least variation in yield under wet and dry conditions, closely followed by D.109.

It is pointed out that the variety D.109, which appears to be rapidly falling off in its general yields, gave the highest one for the year as regards areas of over twenty acres; this was from plant canes. In the same connection, B.208 (ratoons) and D.625 (ratoons) came next, while the lowest minima were scored by the former of these and by Bourbon (plants). In the details that are given of the means of the figures obtained in the juice analysis of each variety in regard to which report of five or more trials were received, B.147 shows the juice with the highest sucrose content and purity, for plants, and B.208, similarly, for ratoons.

Turning now to the results for the period 109-8, the largest yields of commercial sugar per acre for that time have been given by D.625, D.145 and B.208 in this order. Similarly, for the period 1901-8, D.625, D.145 and D.109 head the list for plants and for ratoons. Opinions of the planters as to milling qualities and the fuel value of the megass vary greatly as usual, but Bourbon, Green Transparent, B.376 and D.4,399 appear to be best as regards the former, and the first and last mentioned canes, together with B.41, best in respect to the latter, quality. The highest sucrose content and quotient of purity of the juice, for the years 1904-8, have been shown by B.208, D.74 (four years only) and D.95.

The following statements are made toward the conclusion of the report: "The experiments indicate that many varieties of sugar-cane can be relied upon in British Guiana to give yields of sugar in quantities equal to or greater than those obtained from the Bourbon, and that several varieties possess well-marked ratooning qualities. D.625 and D.145 can be safely recommended for trial on relatively heavy lands,: B.208 is especially suited for lighter soils, and B.376 and D.4,399 appear to be worthy of more extended trials. Certain varieties—the White Transparent and its seedling progeny, D.74, D.95, D.109, D.115, D.116 and D.117—show marked signs of falling off in their yields, especially where grown as ratoon canes, and the committee feel that their cultivation should not be continued except on lands which have proved very suitable to their growth. D.109 showed on many plantations signs of falling off in its yields, especially where grown as second and as older ratoons, although on some it gave very satisfactory results as plant canes. The falling off in the yields of certain of the varieties noticed in this colony is similar to experience reported from elsewhere with varieties of sugar-cane which have been raised from seed. The committee recognize that it is a very important factor, and it is receiving their close attention."

SUGAR IN JAVA.

The annual report of the experiment station for the Java sugar industry for 1908 (Jaarverslag van het Proefstation voor de Java-Suikerindestrie, 1908) has been received. The following notes are taken from an abstract of it kindly supplied by Mr. J. Lely, chemist at the Antigua Sugar Factory.

Mention is made of the sudden dying-out of sugar cane in several cases, and the phenomenon is attributed, in most instances, to the high concentration of salts in the soil water, ammonium sulphate, even, showing an abnormally high percentage. In connection with soil conditions also, a warning is given to the effect that phosphatic manures should not be used for sugar-cane unless chemical analysis has shown that its employment is necessary, for actual harm may result from this and expense is incurred in purchasing a useless manure. [This is interesting in view of the results that have been obtained with phosphates in manurial experiments with sugar-cane in the West Indies.] For the same reason, manuring with filter press cake is not recommended on most soils. The use of potash manures is always advised against, on account of the fact that it is an exceptional circumstance to find too little of this constituent present for the plant's needs.

The question of the advisability of removing the trash from canes is considered. It has been found expedient to strip the lower, dead leaves, as their presence on the cane interferes with the production of roots when it is earthed up. Trashing high up has never been found to be of any advantage, except in the matter of helping to prevent the spreading of cane fires. As regards the methods of planting canes, it has been found, on certain estates, that growing them in rows four feet apart gives a greatly increased yield.

A description is given of a new method for the extraction of sails for the purpose of chemical analysis which has been brought forward by Professor Mitscherlich. In this, a soluton of carbon dioxide in water is used, and special apparatus is required in the process. Experiments on the hygroscopic properties of sugars have shown that, in the case of the higher grades, a saturation of the atmosphere of eighty does not cause any change. Above this, they absorb water; below it, they become drier.

Other subjects of experiment that are dealt with are investigations into the use of "blankit" as compared with that of sulphur dioxide for decolorizing purposes, and the heating value of the megass from different varieties of cane. With regard to the first, it was found that the results from careful sulphuring are as good as those from the employment of blankit, with the additional advantages of lower cost and no loss of sugar. Observations on the behavior of megass in the furnace went to show that that from some varieties of canes possessed a greater heating power than other kinds, chiefly on account of its higher fibre content. This was often conjoined with the fact that the juice from the cane supplying that megass required less heat per ton of cane to evaporate it, thus leading to an increased economy.

The Honolulu Scrap Iron Company, of which Charles H. Brown is manager, has depleted the scrap heaps on many of the plantations and is ready to continue in the work. The company now has a quantity of material on hand to sell to the plantations and is ready to buy and wreck mills for those companies intending to alter or enlarge. The company has an advertisement in this issue.

A CHEAP AND DURABLE MARKING INK.

Editor Planters' Monthly:

Probably many of the Hawaiian sugar factories have had some trouble with the stencil ink used in marking the sugar bags, and have found the mark smeared and unsightly after the bags have been handled. Many of the factories use a ready made ink purchased at the coast, while others make their own ink by mixing up lampblack and other pigment with kerosene, linseed oil, varnish, etc., none of which mixtures are altogether satisfactory, and are expensive in proportion to the amount of oil or varnish used.

The Maui Agricultural Company's Paia mill has been for the past two years making an ink which has been both cheap and entirely satisfactory. It is made by dissolving one pound of glue in one gallon of hot water, then stirring in one pound of lampblack. This forms a semi-solid stock which may be diluted for use with a suitable quantity of hot water. The ink made in this manner dries very quickly, is practically indelible, and will not smear.

The glue may be the cheapest ground glue in the market, costing under nine cents per pound at the plantation, but the lampblack should be of good quality. The ink will not cost over ten cents per gallon if made with lampblack. Where another color is desired any other pigment may be substituted, but a mineral coloring, as red lead, will not give as good results on account of its settling down too quickly. A coloring matter light enough to be held in suspension by the glue-water should be selected where possible.

This ink works well for stamping the bags instead of stenciling them. The Paia mark is an eight inch "2" over a four inch "A," with the lot number under the "A." There are two stamps used, one for the "2 A" and one for the lot number. The first stamp is made of a piece of 1½ inch oak, with a handle set into it, and the figure and letter are cut out from a thin piece of soft wood with a bracket saw, and tacked in position on the oak piece. The lot numbers are carved from oak blocks, three sets of figures from 0 to 9, and the required number of the lot is set up in a light frame and clamped in place with a thum-screw. The stamped mark is clean and clear cut, will not smear, and the marking can be done two or three times as fast as by the use of a stencil.

J. P. F.

ADDRESS DELIVERED BY MR. M. O. LEIGHTON, CHIEF HYDROGRAPHER OF THE UNITED STATES GOVERNMENT, BEFORE THE HAWAIIAN ENGINEERING ASSOCIATION, SATURDAY, AUGUST 28, 1909, 8 P. M.

Mr. Chairman and Gentlemen of the Association:—The work concerning which I am going to talk to you is that carried on by the United States Geological Survey, a bureau of the Department of the Interior. The subjects could better be presented with lantern slide illustrations, but inasmuch as I neglected to bring anything of the kind from the States it will be necessary for me to illustrate by the circulation of some forms which I think, if you crowd close enough together, will answer the purpose very well.

Water, I need not remind you, is the most valuable mineral in the world, a fact which is not appreciated by the people of the country at large. Nevertheless it is so, and should be treated as such in all phases of its investigation and in all its developments. We have had, as a rule, throughout the United States such an abundance of water that it is only within recent years that the need has been felt for investigating its amount and availability for use. While the country was young, while the population was sparse there was enough water for all domestic and industrial needs, but as some parts of the country are becoming thickly settled it has become necessary to take account of stock. In the past a great number of our hydraulic developments have taken place without a proper study of the extent of our water resources. And what has been the result? We are quite familiar with the installations of water power, which have been equipped far too high for the amount of water available; too large investments have been made for the ultimate returns.

In the case of irrigation we have throughout the arid West thousands of miles of ditches, thousands of square miles of waste country, that were equipped for irrigation with the expectancy that they would be a sufficiently large water supply; but all of this is done without proper preliminary study. They found, too late, that the supply was not sufficient. In other words, our hydraulic developments have been too largely by the method of trial and error. From what I have seen in your Territory I assume that this method has in some measure been prevalent here, although I am very glad to acknowledge that there has been less than I had expected.

The history of stream measurements dates back more than a half century. The earliest real investigation was the classic work of Humphreys and Abbot, the United States engineers on the Mississippi river. These men developed certain fundamental principles that with few exceptions have persisted until the present day. Of course, in an investigation of that early date it could not have been expected that the entire trend of the work would ring true after years of proving; some of it was wrong, but it stands today in American history as a classic investigation and the real beginning of American river hydraulics.

We have had other investigations, such as those of Colonel Ellis on the Connecticut river, those of Francis on the Merrimac at Lowell and Lawrence, Mass., those of Fitzgerald on the Sudbury in Massachusetts, those on the Croton in New York, but beyond that our real examination of water resources began in the arid portion of the United States in 1888, for the purpose of determining the amount of water supply in the arid states available for irrigation.

The general methods of stream-flow measurement may be more or less familiar to you. You know, of course, the old float method of measuring streams. A stretch of river is selected with banks fairly abrupt, with channel smooth. Various cross-section areas are measured along the whole stretch, so that the average cross-section of the stream channel can be determined. After that is done, floats properly weighted, so that the proper proportion of their length will be submerged in the water, are started at the head of the course and floated down to the foot of the course, and the time taken. This process is repeated at various distances across the stream and from the results the discharge is computed.

On many rivers, notably in those of low grade like the Mississippi, we really have not been able to improve much on the old float method, if proper corrections are used. We have more convenient methods now, but on the working average day after day and year after year we have not improved much on the accuracy. Float methods are being used today all over the United States, and especially in those streams where the channels are regular and the current not too swift.

We have again the weir method of measuring stream flow, which many believe to be the most accurate of all methods. I think that has been true, but under proper conditions it is no longer true. While it may be as accurate as any, the weir method, that we have been accustomed to consider as a final standard for all hydraulic measurements is quite as subject to error as any of the other methods devised. I know in connection with tests we made last year on one of the canals connected with the Yakima irrigation project in Washington, we found that the wiers, carefully installed, rated and properly operated, were giving quite erroneous results.

The third method in general use for measuring streams is that with a current meter. The current meter is simply a series of vanes revolving on a vertical shaft. The principle is precisely the same as that of the anemometer. The meter is dropped into the water, and by the number of revolutions the speed of the current is determined. Of course, the meter has to be calibrated by moving it at various speeds in the still water before it is used.

I will pass around these two pamphlets so that you can get an idea of the current meter, that is the latest form. This is known as the Price current meter, and you will see in the lower corner of the diagram there are two forms, one for wading measurements, where the meter is attached to a vertical rod and the delivering attachment comes to the ear of the operator; and the other on the left is used for bridge and cable-car measurements, where the meter goes into the water at various depths. We have had in the past a great deal of trouble in convincing some of the older engineers, that it is possible to come within an approximate degree of correctness by the use of the current meter. Probably they were justified in the day that they did their meter work, because the use of the current meter at that time was as crude as was the instrument itself. It was believed at the time that any fool could do current meter work; probably he could: current meter work of that day. But we have learned a good deal, and those who use the meter today are willing to endorse it.

There is a personality we might almost say about every river, and the engineer who has a series of rivers in charge, or a series of measurement stations, knows the peculiarities of his stations. He can make corrections, he can make allowances, and he can prove up on his results. Of course, in establishing, in maintaining current meter stations, it is desirable to have straight uniform sections, with high banks, so that during floods all the water that is brought down will be confined within that channel and not overflow the bottoms. In the establishment of a station in the United States we select the best available section where the current is fairly uniform, where there are no dams which will give back water and establish there at fixed datum a gauge which merely records the stage. In our work we have very few recording gauges, principally because they are not necessary; we hire some resident of the neighborhood to read the gauge once or twice each day. Our rivers when compared with yours in the Territory are so extremely slow in their fluctuations that, as a rule, one gauge reading a day will be all that is necessary. Here, in the islands, I have seen records that show an increase of four or five times in the flow of a ditch during a period of two hours. Our rivers sometimes go up very quickly in the United States; usually they drop more slowly, and the gauge-reader, the man who is permanently located at the station-point, is expected to use his good judgment in such times and take as many readings as the conditions warrant. He is especially instructed to get the beak of floods, even though he has to stay on the ground for hours and wait for it. I say "he," more often it is "she." Of course, we have difficulty in getting faithful men; we have very little difficulty in getting faithful women; the good old-fashioned school-marm is the best gauge reader in the world; and we get them as often as we can. But there are places, in the West especially, where it is necessary to place a measurement station, and where there is no one within a distance of several miles to read the gauge. There it is necessary to put in recording weirs, and there we generally have trouble, because there are really no good rcording weirs on the market at the present time for river work. There are some excellent ditch weirs, but in the case of rivers where the amplitude of the state may vary from zero to forty feet there is nothing in the shape of a record gauge that will encompass that amplitude yet. We expect there will be some, have been expecting that for ten or more years, but at the present time our hope lies with the W. and J. E. Gurley Company, which is based on the electrical contact, the gauge height being recorded by type on a ticker-tape, just like the stock-ticker arrangements you find in the brokers' offices.

In addition to the gauge-height, of course, it is necessary to determine the actual volume of the flow, and this is accomplished by having the engineer in charge visit the aforesaid station every so often and make a discharge measurement with the current meter. It is his purpose to go to the station at as many different stages as he can, so that he will cover the entire range in the fluctuations, and thereby fix the foci for his rating table. In a permanent station for example we know with a gauge height of two feet the flow must be so many cubic feet per second. At a gauge height of ten feet it is so much more, etc., so that after two or three years we will have enough points in the scale so that frequent current meter measurements may be abandoned, and we can read the actual discharge practically right off the staff gauge or the chain gauge, as the case may be.

Now, I will distribute among you some forms that are used in the work, and will talk directly to them.

The first form, No. 9277, is the Field Note-book Sheet, giving the description of the river station. All of the queries on this sheet are necessary in the administration of the station. In the preliminary queries there is the location of the station with respect to towns, bridges, highways, railroads, etc., etc., falls, islands and dams. It makes a lot of difference in the cost of maintaining a station, also its cost of establishment whether the measurements can be taken from a bridge, whether it is necessary to use a boat, or whether it is necessary to erect a cable over the river and take measurements from a trolley car.

Then we have description of location and location of gauge. We are obliged to use several kinds of gauges. The usual staff gauge is not suitable in the majority of places, especially in the northern regions where the river freezes over, or in the timber country where the logs come down and frequently dislodge the gauge. Then the floods, of which we have a great number in many parts of the United States, will carry them out without the aid of any detrital matter at all, but wherever the proper protection can be secured for a staff gauge we use it because it is the simplest and most practical instrument. Where this is not possible we generally use the chain gauge. This consists of a length of ordinary window chain, attached to which is a window weight. The chain passes over a pulley, and the horizontal gauge is set to datum. The gauge reader lowers the chain until the window weight just reaches to the surface of the water. The end or the pointer on the chain is then laid on the horizontal gauge and the reading is taken. He then pulls the chain up, puts it in the box and all the apparatus is locked up. That is the most practicable gauge that we have, where there are suitable bridges or trees that are stable enough to maintain their original level.

We have in some cases to use monuments for gauges. There are wide sandy channels in which it is not possible to erect any one gauge that will reach all ranges of stage. Sometimes certain rivers will be six feet wide, sometimes again the same river will be one quarter of a mile wide and the maximum depth will be from eight to ten feet. In that case it is necessary to have a series of monuments from the middle of the channel clear up to the outermost edge of the channel, and the readings are taken from one monument to the other as the river recedes.

A glance at the queries on this blank will give you a good idea of the information that is necessary in order to carry the work along.

In passing over these things, if I do not make them all clear I hope you will interrupt and ask as many questions as you choose.

Passing now to the next form, No. 9277: Current meter notes. That is simply a convenient loose leaf field form, and the headings at the top of each column give you the items that are necessary to final computation of discharge.

The next form is 9-210, is the office and sub-office rating table record, with the proper queries and notations at the foot. You will see that it can be used for any sort of channel rating; the decimals of feet in gauge height only being given, and the convenient prefixes can be put on according to the channel. The whole thing will suggest the method by which we keep these channel ratings. I should say, by the way, that there are a great many channels that change their ratings from year to year; of course, they are of the shifting kind. We may be able to use one rating for a year or two, then by reason of some fundamental change in the channel itself it is necessary to make a new rating from the more recent measurements.

9-212 is the next form, and is merely an office record of the gauge heights. All our office records are in note size and filed in vertical files. The observer's record, however, is kept on such a book as that. It is returned to the district office whenever it is completed.

Now, the two final forms are for finished data.

Form 9-220 gives a resume of mean monthly discharge, during the entire year. You will see all our discharge is computed in cubic feet per second, or as we use the contraction second-feet. It gives the maximum and minimum discharge in second-feet for each month of the year and the discharge in second-feet per square mile on drainage area.

You will see under the heading next of "Run-off" another series of expressions which are used in various ways. The per cent. of rainfall is another expression of various uses if it can be properly determined. It is a lamentable fact that we know almost as little about our rain-fall as we do about our stream-flow. Our rainfall stations in the United States are not always located in the regions where they are most needed. That is also true in the Territory of Hawaii even to a greater extent. Many of the places in which stations would be useful are too remote for station maintenance or are too costly to install.

I do not know of anything aside from stream-flow data that is of more importance today than a thorough revision of our rain-dam data, and the equipment of stations where they ought to be.

Now, the title in "acre feet"—continuing with this form—is a storage expression; a most useful one. I hope you engineers in Hawaii will use it instead of "million gallons per day." An acre-foot is something that is easily transferable into other units or other expressions, and means much in irrigation. If you have a reservoir with a capacity of a million acre-feet, and you had a million acres to irrigate it one may without computation know that the reservoir water will cover that land just one foot deep. The engineering profession is adopting it; and I think you will find it much more convenient than your expression of gallons per day. Finally we come to form 9-192, which is the official yearly record of a station. I do not need to go into details any. You will see what it covers. It is the final say-so of the Geological Survey. We put different reports in this form. They are printed in our progress reports in this way, and I think for the whole year's recording in stream changes it is about as compact as anything that has ever been designed, and exceedingly convenient for use in the office. A man can take this record and pull out of it just what he wants in the way of data for water power, irrigation, domestic supply or anything else.

Now, I have just a few more points to consider with you, namely: the application of such studies to engineering development.

We do not have to argue very much with engineers now about the necessity for stream-flow measurements in irrigation works. Ten years ago it was quite a task to convince many of the engineers that it was unsafe to build a great system of irrigation works and put people on broad acres without knowing how much water they had and how much land they could cover. But, of course, stream-gauge work is fundamental on all successful irrigation that depends on water supply. You take for example the United States Reclamation Service. The government has expended fairly close to forty-five millions of dollars in irrigation works in the West. Had it not been for the fact that the Geological Survey began to maintain gauging stations there, away back in 1888, the Reclamation Service would have been unable to make the world's record in construction that it has made. It was merely necessary that the Reclamation Service expend any time in stream measurements. The data were already collected and the Reclamation Service determined whether this or that or the other project was or was not feasible. It is generally admitted, that the few hundred thousand dollars that have been put into stream-gauges in the arid West is in the form of insurance of the government in its expenditure of forty-five millions.

It was very hard, has been very hard, up to within a few years to convince the every-day engineer that he ought to know something about the flow of streams, before establishing water-power plants. I can mention several big plants in construction that were equipped with apparatus twenty or twenty-five per cent. higher than will ever be utilized. Of course, it is necessary to have a long series of records in the case of water-power installation, because the amount of water-power available now in the stream is absolutely determined and fixed, not by the highest flows but by the length and severity of the low water period, and moreover the low water period in the lowest year. Now, in the United States the work that has been going on in the eastern part of the country since 1895 has resulted in the establishment of over two hundred and fifty million dollars worth of water-powers on streams and in places where they would not have been established for a long time to come had not the information been made available. The work has shown where there is water-power. I do not know how many million dollars worth of money has been saved by the discouraging results that the reports have had upon promoters who wished to put water-power plants in places where there was not sufficient water to turn the wheels.

Then we have the relation of stream-gauging to inland water navigation. There have been some interesting developments along that line. The government has pursued for years the development of inland water navigation along our big rivers without giving very much consideration to the amount of water. That has been corrected of late years. The engineer corps is using in large measure stream-flow measurements of the Geological Survey. But you can appreciate how necessary it is to know in the construction of a series of dykes how much channel capacity you must have to leave between those dykes in order to carry off the flow. You can appreciate how necessary it is to know in the channels of the river where you are putting in a series of locks and dams how little water you have to operate these pools and dams with.

But probably the newest appreciation that we have of stream measurements is along the line of flood protection. We have in the past been looking upon floods as a necessary evil, in large measure. Of course, along our great navigable streams levies have been constructed to wall in the floods, but we have accepted the losses without very much annoyance except in cases like that of the Johnstown flood where they killed a few thousand people. The facts are that our flood losses in the United States have averaged over a hundred million dollars a year, that is merely the physical loss; it was something like two hundred and forty million dollars in the year 1908. The whole flood question begins to be appreciated when we can figure up an average of one hundred million dollars physical loss each year. That does not take into account the interruption to trade, the loss due to suspension of labor, and the damage that it causes in depreciation of land values.

Now, it is necessary to study stream flow in order to suitably provide protection against flood loss. On many of our rivers the way to handle floods is to close them in with levies. On other rivers it is necessary or desirable to build reservoirs in the high land to hold the water.

One thing I have not mentioned, and that is the loss of the water itself. A flood is a waste of water, astonishingly so, and if the reservoir had no other purpose than that alone it would amply justify all that it costs. But, of course, we know that this is only a part of its benefits: a reservoired stream is more navigable, it produces more power, it will irrigate more acres of arid land.

There is still another feature where stream gaugings apply, not generally appreciated by the people of the mainland; probably it has not occurred to you: that is in the drainage of swamp lands. In the United States seventy million acres of the finest and richest land that we have cannot be used for agriculture because it is too wet. Some of it which has been reclaimed is worth four hundred and five hundred dollars an acre. The problem of drainage in the United States is as big as the problem of irrigation. Now, what do we do in draining a great area of say twenty, thirty or forty thousand acres? It is not merely sufficient to dig ditches to take out the water. When we drain a great area like that we change the character of that enormous stretch of land, from slow-spilling to a quick-spilling area. It would be the same as if we took that flat swamp land and placed it on the side of a mountain so that the water would run off quickly.

Through countless years the streams draining these great swamps have adapted the capacity of their channels to the amount of water they will have to carry. They may overflow at times, but as a rule they can carry about all that they get through these swamps. Now, when we change the character of that great swamp country from a slow-spilling and a quick-spilling area, we are simply dumping into the rivers far more water than they can take off. So it is necessary to determine what they are now producing per square mile per year, and what they will produce per square mile per year after they have been drained.

Now, the problem in Hawaii is a new and an inspiring one, because it plunges into conditions which we have long hoped to investigate in the United States, but which so far we have failed to do. Here the study of stream flow involves an intensive study, a study that involves the minute consideration of drainage from small areas. We need such work in the United States, but we have never had the money to do it. It has been necessary to spread our stream gauge work over wide areas. I believe in the United States now we have one station for every sixty-five hundred square miles of drainage area. It has been a broadcast extensive study, and we have not been able to get to the little streams in the mountains and do any real fundamental hydrologic studies. Each year we have hoped to be able to do it. Now when we come here and find that the study in this country, the fundamental study, is the very one we have been trying to work up to in the United States, we are, of course, greatly pleased. We want to be able to carry the work on here in the same way as we do in the United States.

In the study of this stream flow the work is going to be slow in its progress, because it is going to be difficult to start. It is going to be expensive in the installation, and so for a series of years it will be a matter of collecting data, and until we have covered a cycle of conditions, or a period sufficient so that we know what may be expected in the driest year and in the wettest year. This work must go on in that way if it is going to be of any value to your people. And that suggests continuity. The most important thing about this work will be the coöperation of the engineer and those who are interested, so that the work will not be stopped before it is complete. Hydrographic work stopped before it is done is work thrown away. You may here and there get some results that are worth while, but as a rule you may as well throw away all hope of benefit from the money expended. If you engineers of the Territory would make it one of your cardinal principles that you will support this work, and insist upon its continuity until it is done, you will render a great service. I wish that your society might take an interest in the matter.

You engineers, it seems to me, stand in an enviable position. You are in the beginning or in the early days of a wonderful area of development. The future of this country depends largely on engineering development. As I have been over the three islands I have seen the possibilities for engineering work in the way of road construction, both steam and highway, reservoir construction, irrigation, water power, and everything in the shape of field engineering that should warm the cockles of an engineer's heart. I am sorry I am not going to be here to take part in it. I think that it is a wonderful opportunity. The best of it is you have so few mistakes to correct. On the mainland, the greater part of engineer practice consists in the rectification or the correction of plans and developments that were wrongly conceived and wrongly started in the first place. It is only now and then that an engineer in the States gets an opportunity to work out what may be called an anticipatory plan, a plan that he can start that in the beginning in the field and carry it through till the end. Generally we are obliged to knock down some other fellow's work and build it right, or build it as we think is right, and wait for some other fellow to knock down ours. That is especially so in government work. But here you have a virgin field; you have carried on a certain amount of development, and wondrous development it is too; and you have so few mistakes to correct. such a broad field in front of you that it is apt to make an engineer from the mainland, like myself, extremely jealous.

WANTED.